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ATTACHMENT B

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Description:	Leadframe-based component housing, surface-mount electronic component and manufacturing method
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March 29, 2006

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Description

Leadframe-based component housing, leadframe strip, surface-mount electronic component and manufacturing method

Subject of this invention is a leadframe-based component housing, a leadframe strip with pre-molded component housings, a surface-mount electronic component, namely a component with a radiation-emitting or radiation-detecting chip, for example, a light emitting diode, also called LED (LED = Light Emitting Diode), as well as a method for the manufacture of the leadframe-based component housing.

The invention especially concerns surface-mountable light emitting diodes, wherein an injection-molded base with a partially embedded electric connector strip contains a recess - preferably in the form of a reflector - with a radiation window in the direction of the front of the component housing. The recess, in which an electromagnetic radiation-emitting chip is located, may, for example, be filled with an encapsulation compound permeable by the electromagnetic radiation emitted by the chip.

Such component housings can also be used for radiation-detecting chips - in this case, the electromagnetic radiation must be able to permeate the window in order to be received by the chip.

The invention is especially useful for applications with radiation-emitting components, where the chips are integrated into pre-manufactured leadframes, so-called "pre-molded leadframes". This means that the bases of the housings

are molded to the leadframe prior to the chips being installed on the base.

In the manufacture of such a component housing, the connector strips are first partially stamped into a leadframe strip. Afterwards, the leadframe strip is placed into a two-piece injection mold, which forms a cavity around the leadframe for the base.

Subsequently, a spray nozzle is used to fill the part of the injection mold bordering on the backside of the leadframe, i.e. the part of the cavity bordering on the backside of the leadframe, with a white synthetic compound, subsequently filling the entire cavity of the mold.

After the compound is at least partially cured, the mold is opened and the spray nozzle is removed, whereby the compound in the spray nozzle breaks away from the compound in the cavity. Furthermore, the chip should be placed in the recess designed for this purpose (preferably on one of the connector strips), and the encapsulation compound would be applied. In the final step, the component will be separated completely from the leadframe strip.

A radiation-emitting component of the said type is described in BP 0 400 176 AI. This component has a base with a supporting surface, into which a leadframe is partially embedded. Parts of the leadframe are configured as connector strips, which protrude from the base, and which are bent so that their contact surfaces are flush with the supporting surface, which constitutes the installation plane of the component.

The total height of the components manufactured in this manner cannot be reduced to less than approx. 1.7 mm, whereby

the minimum height of the front part and the back wall of the housing base is 0.8 mm, and the thickness of the connector strip is approx. 0.1 mm.

The reason is that the layer of the injection compound in the cavity between the leadframe und the break-away point at the spray nozzle must be thick enough to prevent delamination between the back of the leadframe and the molding compound as much as possible. Such delaminating would sharply increase the danger of damage to the component during further processing or later during operation. According to the current state of the art, the thickness of said layer must be such that the mechanical pulling forces generated by the removal of the spray nozzle will be reduced to such extent that the forces attacking the boundary to the leadframe are not strong enough to separate the molding compound from the leadframe.

For example, in order to achieve a small installation height on printed circuit boards and/or to countersink components especially in round conductor openings (holes), the components must be as low as possible, and there is an urgent need to lower the installation height below the minimum height of the above mentioned 1.7 mm. In some applications, especially in mobile communication devices, the radiation-emitting components must have a distinctly smaller height.

The option to reduce the component height by reducing the height of the component base via the chip is very limited due to the finite height of the radiation-emitting chips. The option of achieving this goal by simply reducing the thickness of the housing base at the back of the leadframe is also extremely limited because, as already explained above, if the layer of the molding compound for the backside of the housing is too thin, it will be broken off during the

injection molding process when the spray nozzle is removed, whereby the hermeticity of the component is destroyed, thus compromising the functionality of the component.

It is therefore the objective of this invention to provide a leadframe-based housing for an electronic component, especially a low-height radiation-emitting surface-mount component, said electronic component, a leadframe strip as well as a method for the manufacture of such a leadframe-based housing.

The problem is solved by a leadframe-based housing with the characteristics of patent claim 1, by the leadframe strip with the characteristics of patent claim 6, by an electronic component with the characteristics of patent claim 7, and by a method with the characteristics of patent claim 13. Advantageous advanced embodiments of the invention are described in the dependent claims.

A leadframe-based housing as described in the invention for a surface-mountable electronic component is composed of the following elements:

- a leadframe with a front side and a back side, including at least two electric connector strips,
- a molded base, preferably injection-molded or transfer-molded, made of an electrically insulating molding compound,
- a front part on the front side of the leadframe, and a back wall of the base on the back side of the leadframe,
- at least one injection window in the leadframe to attach or insert a spray nozzle, through which the molding compound is injected onto the leadframe from the back of the leadframe.

The molding compound is thus injected from the back of the leadframe through the injection window into the part of the cavity of the injection mold, which creates the front part of the base at the front side of the leadframe. During the molding process, the spray nozzle is passed through the part of the cavity creating the back wall of the housing base at the back of the leadframe to the molding window of the leadframe. The result is that a relatively large molding compound volume with a relatively large cross-section is now bordering the spray nozzle and thus the break-away point of the molding compound at the cavity end of the spray nozzle. The danger of delamination for this type of housing is therefore reduced.

The injection window is preferably located in one of the electric connector strips. The back wall of the housing base has preferably a thickness of 0.6 mm or less, preferably of 0.4 mm or less.

The invention is especially well suited for components with at least one recess for the insertion of a chip in the front part of the housing base, especially a radiation-emitting or radiation-detecting semiconductor chip, e.g. a light-emitting diode.
The molding window is in this case most preferably located in the area of a barrier delimiting the recess on the front part. There, due to the architecture, a large volume of molding compound is already present.

The recess has a surface for the installation of the chip, which is preferably located on one of the two connector strips, but which may also be located on the housing base. Such chip installation support can also be inserted later into the recess in the form of a carrier platelet. Also conceivable is that a thermal connector socket is inserted into the

housing base, which preferably extends from the bottom of the recess through the housing base into its back side.

The chip, depending on the configuration of its contact surfaces, may be

- electrically connected to the electric connector strip via two bonded wires,
- attached to a contact surface on one of the two connector strips via an electrical connecting compound, and connected to the second connector strip via a bonded wire, or
- be placed directly with its contact surfaces onto the strips via flip-chip mounting.

Other electric connection variations are, of course, also possible, which the professional will select depending on the design of their chip.

For radiation-emitting components, which is the preferred use of this invention, the recess has a window through which the radiation can exit. The inner surfaces of the recess are in this case preferably configured as radiation reflectors.

Alternatively, the entire housing can be made of a radiation-permeable material, and may completely enclose the radiation-emitting chip.

The molding compound is preferably made of a synthetic material, namely a plastic filled with white filler. The plastic is preferably a type of thermoplastic material, and the filler is preferably titanium oxide.

Suitable materials for the enclosure of the chip in the recess, including thermosetting resins like epoxy resins,

acrylic resins and silicone resins are known to the professional, and will therefore not be discussed further.

The same applies to the molding compound of the housing base. Regarding the installation and electrical contacting of chips, known and commonly used methods may be applied advantageously here as well.

The procedure according to the invention includes the following steps:

- Pre-structuring of the connector strips and the injection window in a leadframe strip, for example, through stamping, whereby preferably multiple adjacent (periodical) component sections are formed in the leadframe strip, into which one housing base each is placed at a later time,
- Attaching of a two-piece injection mold to the leadframe,
- Injecting of the molding compound into the injection mold through the injection window, whereby the spray nozzle of the injection machine is placed on the injection window or inserted into the injection window,
- At least partial curing of the molding compound, and
- Opening of the injection mold, and removal of the nozzle.

The injection window described in this invention for a housing base with recess for a chip is most preferably located below a massive barrier of the housing base, which at least partially encloses the recess.

The manufacturing procedure described in this invention has the special advantage that the total height of a component housing made with this process can be significantly reduced due to the especially thin back wall of the component housing, especially in comparison to the already known radiation-emitting components, which are made with pre-manufactured housings.

Other characteristics, advantages and enhancements of the invention result from the embodiments explained in connection with Figures 1 to 4.

The following are shown:

Figure 1 is a three-dimensional schematic view of a state of the art radiation-emitting component manufactured with the pre-mold method,

Figure 2a is a schematic top view of a leadframe strip as described in this invention,

Figure 2b is an enlarged schematic top view of two matching connector strips of the leadframe in Figure 2a,

Figure 2c is a schematic top view of a leadframe strip per Figure 2a with housing bases as described in the invention, made with the injection method,

Figure 3a is a schematic top view of another embodiment of the connector strips of a component per this invention,

Figure 3b is a three-dimensional schematic bottom view of a component housing as described in this invention with a leadframe according to Figure 3a,

Figure 3c is a three-dimensional schematic top view of a component housing per Figure 3b,

Figures 4a and 4b are schematic cross-sectional views of the component base of a state-of-the-art component (4a) and a component as described in the invention (4b) during the injection molding of the housing base.

Equal or equally functioning elements have the same reference numbers in the figures.

Figure 1 shows a three-dimensional view of a surface-mount component with a state-of-the-art housing.

The housing base 100 with a rectangular outline shown in Figure 1 has a front part 8a and a back wall 8b, wherein the front part 8a has a reflector recess with a window 12, through which the radiation can exit. A first connector strip 2a and a second connector strip 2b are partially embedded into the housing base, and connected to a radiation-emitting chip (hidden inside the housing base 8), which is not shown here. The protruding parts of the connector strips (outer contacts) are used for the installation of the component, e.g. on an external printed circuit board. The outer contacts can be located perpendicular to the corresponding sidewall of the housing or, as suggested by the broken line in Figure 1, bent around the housing base.

The leadframe strip 1 according to the embodiment of Figures 2a and 2b has been pre-configured by stamping, and has multiple first connector strips 2a and multiple second connector strips 2b, which in a later manufacturing step will be separated from the leadframe strip along lines 3a and 3b.

The connector strips 2a and 2b are the cathode and anode connection of the components to be manufactured. The leadframe strip may also contain additional configurations (e.g. heat-dissipating strips). Connector strip 2a has, according to this sample embodiment, a chip installation area 14 for a chip, or on connector strip 2b a wire connecting area 13 for a bonded wire. The first connector strip contains

according to the invention an injection window 24, into which a spray nozzle can be inserted when the housing base is injection molded. The injection window may alternatively be located in the second connector strip 2b. For practical purposes, the injection windows should be located below a sidewall of the housing base, which will be created later.

The chip installation area 14 and the wire connecting area 13 of the leadframe strip extend (in the finished housing base) into a reflector recess or border with at least one surface on the inside of the recess, and form at least a part of the bottom surface of the recess. Regarding a further reduction of the housing base, the reflector recess may have an additional recess leading to the wire connecting area. These aspects are identifiable in Figure 3c.

The leadframe strip 1 furthermore contains circular openings 6a and 6b, through which the leadframe strip can be routed.

Connector strips 2a and 2b furthermore contain preferably rectangular openings 21 to be used as strain relief for the component housing when bending the connector strip (see Figure 1).

Figure 2c shows the leadframe strip 1 with a housing base 100 manufactured according to the invention with an injection molding process with a chip installation area 14 and a recess leading to the chip installation area.

The sample embodiment of a leadframe for a housing or component as described in the invention with a circular outline shown in Figure 3a exhibits crescent-shaped connector strips, which on

one hand provides a better anchoring of the connector strips in the housing base, and which on the other hand serves as strain relief during the bending of the connector strips. This leadframe exhibits next to a chip installation area a molded window 24, into which or against which a spray nozzle can be inserted or placed in order to create the housing base.

Figure 3b shows a three-dimensional bottom view of a housing base 100 as described in the invention with a circular outline. Visible is the molded window 24, through which the housing base 100 is injected into the cavity of an injection mold into the part of the cavity bordering on the front side of the leadframe. The rest of the front part of the housing base 100 is in this embodiment designed as shown in Figure 3c. This type of housing is especially well suited for the manufacture of surface-mount, radiation-emitting and/or radiation-detecting components with light-emitting diodes and/or photo diode chips, which may be at least partially lowered into the circular openings of printed circuit boards or other carriers.

A three-dimensional view of the component in Figure 3b is shown in Figure 3c. A radiation-emitting chip 16, e.g. a light-emitting diode chip, is fastened to a reflector opening on connector strip 2a. The bonding agent is e.g. metallic solder or conductive glue.

A second contact of the light-emitting diode chip is, for instance, electrically connected to connector strip 2b via a bonding wire 17a. The sidewall 11 of a recess connecting the bottom section of the recess with the outer surface of the housing base 100 is designed to function as a reflecting surface for electromagnetic radiation emitted by the chip 16. Depending on the desired radiation, it may be flat, concave, or have any other useful shape.

The protrusions 10a, 10b and 10c of the housing base shown in Figure 3c are used to route the connector strips outside the housing base.

On the front side, facing away from the connector strip, the chip 16 has a contact surface, from which an electric lead 17 (e.g. a wire) leads to the wire connector 13.

The special advantage of the invention becomes easily apparent upon the comparison of the state of the art and the invention in Figures 4a and 4b.

The front part of the housing base 100, which may be used for the later installation of a light-emitting diode chip, exhibits in both cases a reflecting recess in the shape of a truncated cone, which expands in the main direction of the radiation, with a radiation exit window 12. The reflector recess is filled with transparent encapsulating compound 41.

A chip 16 to be installed in a later production step, and an electrical connection lead 17 are schematically suggested with broken lines.

The tilted side surface 11 of the recess preferably serves as reflector.

For the forming of the housing base 100, a two-piece injection mold with a cavity for the housing base 100 is being used, into which the leadframe is placed during the injection molding process. Using a spray nozzle 23, the cavity of the injection mold is filled with the injection compound for the housing base.

The difference between the state of the art and the configuration of the spray nozzle in this invention is shown in the position of the spray nozzle 23. In the state of the art version, the injection compound is injected into the volume at the back of the leadframe. After the molding compound has hardened, the spray nozzle is removed from the injection mold. This creates a breakpoint 25. While the spray nozzle is being removed, the area close to the breakpoint is exposed to great mechanical stress, which may lead to the delamination of the material of the (cured) molding compound at the boundary between the back wall 8b of the housing base and the connecting strips 2a and 2b. Therefore, the back wall 8b can be easily damaged if it is not high enough. In order to prevent this from happening, the back wall 8b of the housing base must be relatively thick.

In the version of a leadframe-based housing according to the invention however, the spray nozzle 23 is not inserted into the center section of a cavity to form the back wall 8b of the housing base, but is instead brought up against an injection window 24 or inserted into the injection window 24, which is located at the side of the leadframe. Thus, the breakpoint 25 is not located across from the leadframe but borders on the molding compound of the massive sidewall of the housing base. This allows the manufacture of a very thin back wall 8b of the housing base 100, and therefore the manufacture of a component with a small height. A thickness of 0.4 mm or less can be realized.

Since the back wall of the housing base forms according to the invention a low-height component, the vertical space requirements for the component are much less than for components manufactured according to the state of the art.

The component described in the invention is especially well suited for flat display modules or as background lighting

for liquid crystal displays, for example.

The explanation of the invention based on the shown embodiments should, of course, not be understood as a limitation of the invention. The chip, for example, can be installed (e.g. glued) directly onto a chip installation surface of the housing base 100, and the chip may be electrically connected to the connector strips by wires only. The chip may also be installed on a separate thermal connector embedded into the housing of the component, and again be electrically connected with wires to the leadframe. Other chip installation methods not described in this document may be used as well. All of these embodiments do not stray from the basic idea of the described invention. The invention is not limited to the number or special sample embodiments schematically shown in the figures.

Patent Claims

1. Leadframe-based housing for a surface-mountable electronic component comprised of a leadframe with a front side and a back side, exhibiting at least two electric connector strips (2a, 2b), and an injection-molded or transfer-molded housing base (8a, 8b) made of an electrically insulating molding compound, with a front part on the front side of the leadframe and a back wall on the back side of the leadframe, wherein the leadframe exhibits at least one injection window (24), through which the housing base is molded from the back side of the leadframe onto the leadframe.

2. Housing according to claim 1, wherein the injection window (24) is located in one of the electrical connector strips.

3. Housing according to claim 1 or 2, with the back wall exhibiting a max. thickness of 0.4 mm.

4. Housing according to at least one the claims 1 to 3 for a radiation-emitting and/or radiation-detecting component, where the front part (8a) of the housing base (8a, 8b) exhibits a recess for the acceptance of a radiation-emitting and/or radiation-detecting chip, where the injection window (24) is located in a recess-delimiting wall at the front.

5. Housing according to claim 4, wherein the recess is designed as a reflector.

6. Leadframe strip with at least one housing according to one of the claims 1 to 5.

7. Electronic component with a housing according to at least one the claims 1 to 5, including at least one chip (16).

6. Electronic component according to claim 7, wherein the, at least one, chip (16) is a radiation-emitting and/or radiation-detecting chip.

9. Electronic component according to claim 7 or 8, wherein the chip (16) is installed on one of the two connector strips (2a), and electrically connected to the second connector strip (2b) via an electrical lead (17).

10. Electronic component according to claim 7 or 8, wherein the chip (16) is installed on an installation point of the housing base, and electrically connected to each of the electric connector strips (2a, 2b) with an electrical lead (17).

11. Electronic component according to claim 7 or 8, wherein the chip (16) is installed on a chip carrier with good thermal conductive characteristics passing through the housing base to the back side, and electrically connected to each of the electric connector strips (2a, 2b) with an electrical lead (17).

12. Electronic component according to at least one the claims 8 to 11, with a housing reference to claim 4 or 5, wherein the recess is filled with a sealing compound, which is permeable

for the radiation emitted by and/or to be detected by the chip.

13. Method for the manufacture of a leadframe-based housing according to one of the claims 1 to 5 with the following process steps:

a) Leadframe with both connector strips and injection window (24),

b) Application of a two-piece injection mold onto the leadframe forming a cavity around the leadframe for the creation of the housing base, and insertion or attachment of an spray nozzle in or against the injection window (24),

c) Injection of the molding compound into the cavity,

d) At least partial curing of the molding compound, and

e) Opening of the injection mold, including removal of the spray nozzle.

14. Method according to claim 13, wherein the injection compound is a thermoplastic material.

Summary

Leadframe-based component housing, leadframe-strip, surface-mountable electronic component and manufacturing method

The invention describes a leadframe-based housing for a surface-mount component, especially a radiation-emitting component, wherein the leadframe-based housing exhibits electric connector strips and at least one chip installation point, and wherein one of the connector strips exhibits according to the invention an injection window, allowing the injection molding of a low-thickness leadframe-based housing. Furthermore described is a method for the manufacture of this type of housing.

Figure 4b

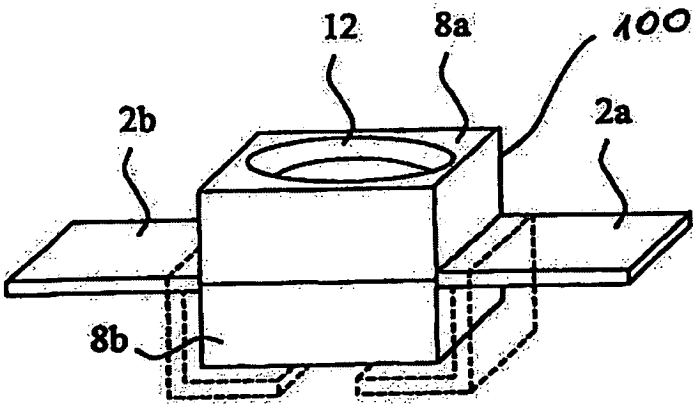

Fig. 1 (State of the Art)

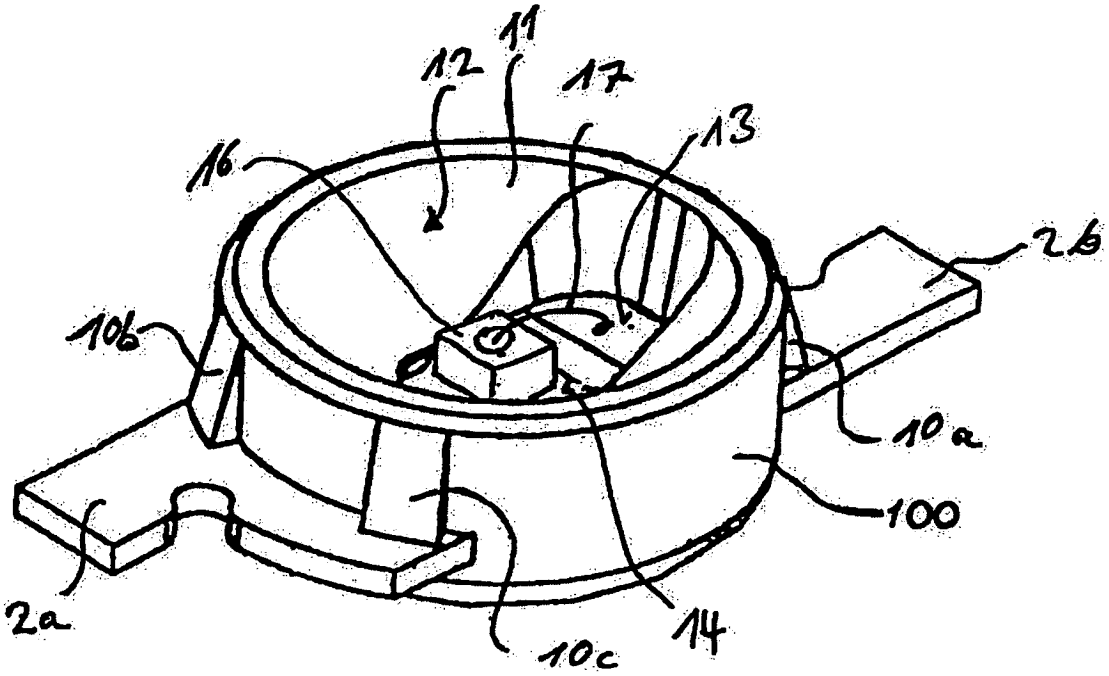

Fig. 3c

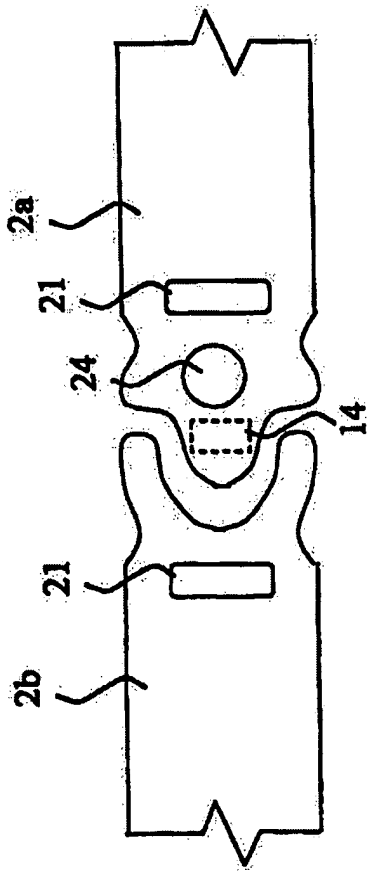

Fig. 2b

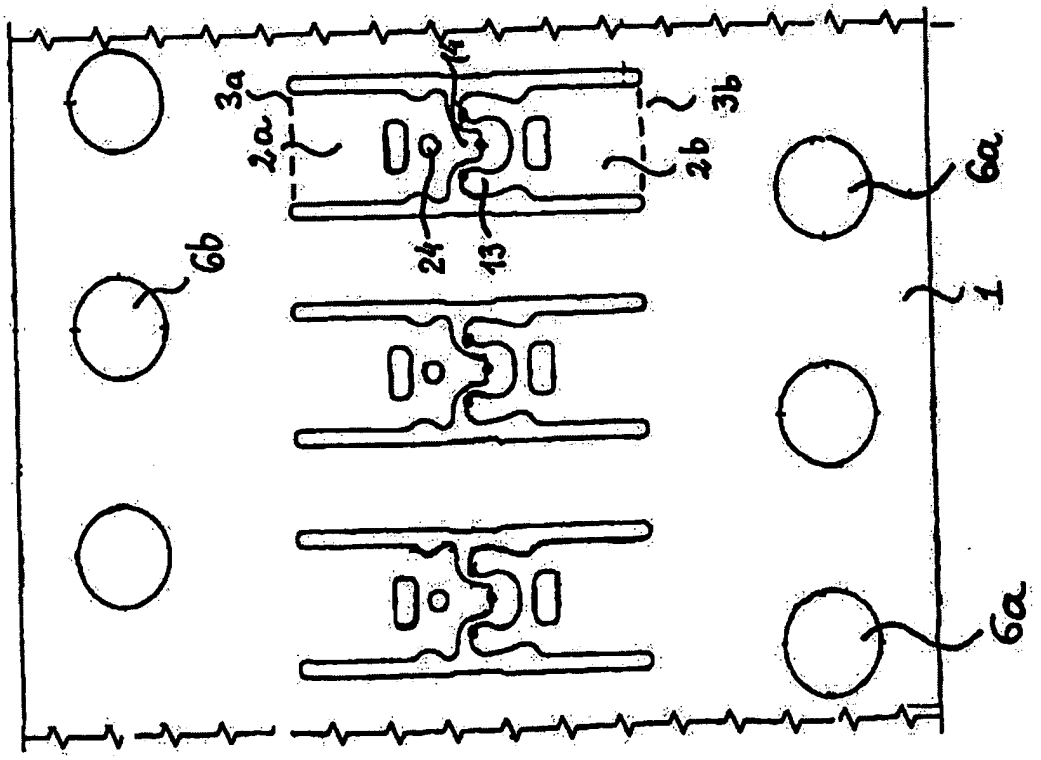

Fig. 2a

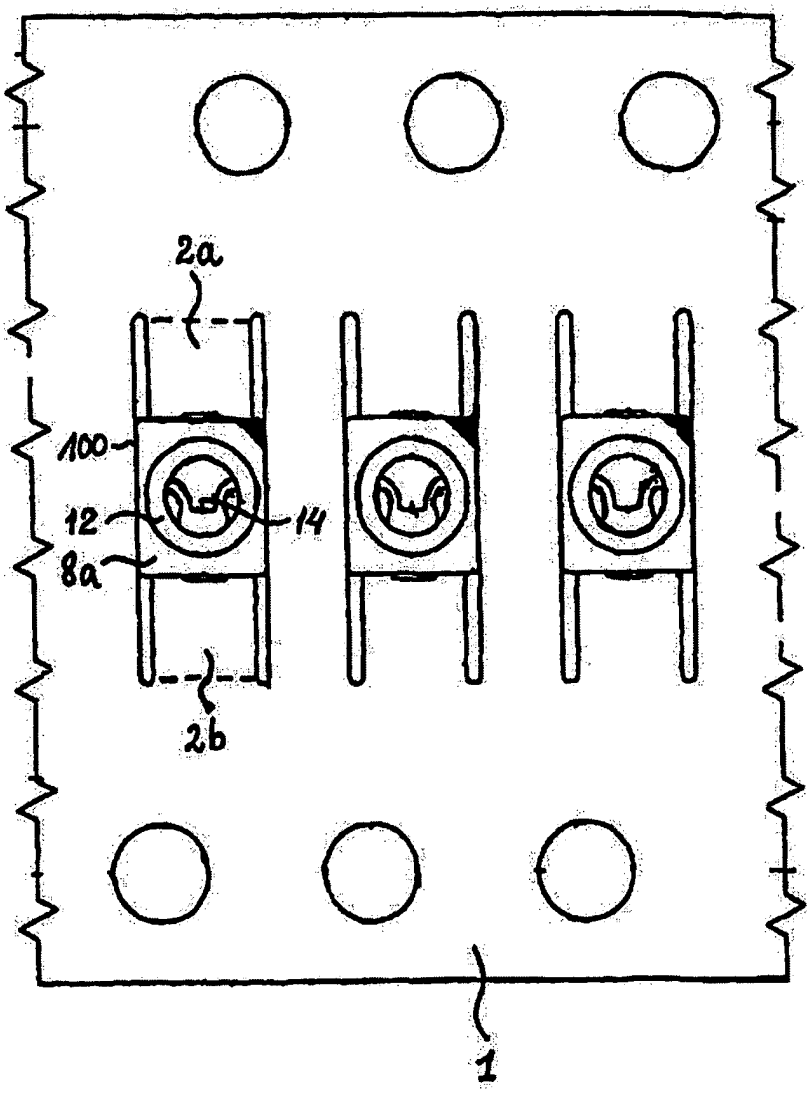

Fig. 2c

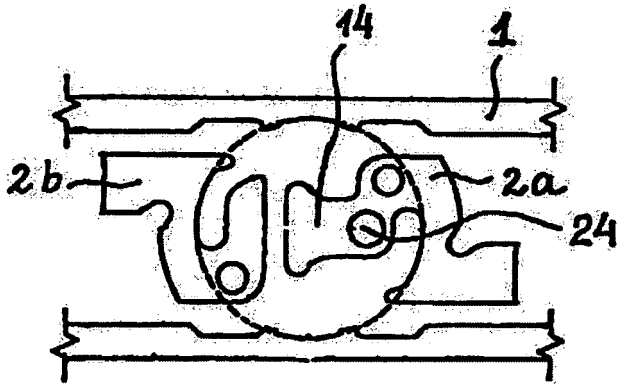

Fig. 3a

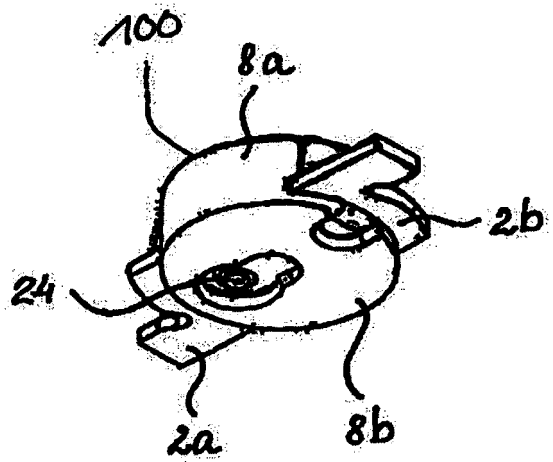

Fig. 3b

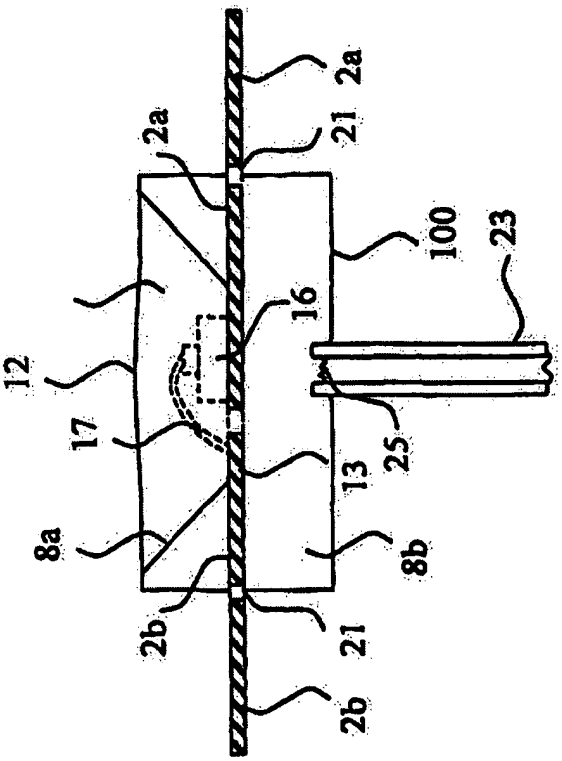

Fig. 4a (State of the Art)

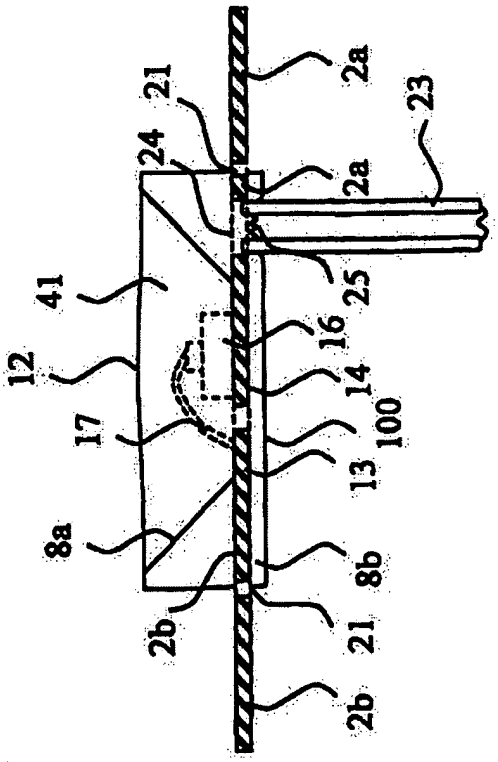

Fig. 4b